CHANGE 2 TO NAVSHIPS 91634(A) APPROVED 10 September 1956

This permanent change revises the book to reflect the equipment changes made by Field Change 2-AN/SPS-5. The Field Change applies to all serial numbers of Radar Set AN/SPS-5. Its purpose is to provide a means for indication of voltage standing wave ratio.

This permanent change is in effect after Field Change 2-AN/SPS-5 has been made. Therefore, DO NOT revise the book until the field change has been accomplished

1. Remove superseded pages and insert revised pages as indicated below.

Page	Remove	Insert	Page	Remove	Insert
TP/A	CH. 1/CH. 1	CH. 2/CH. 2	1-3/1-4	ORIG/ORIG	CH. 2/CH. 2
i/ii	ORIG/ORIG	CH. 2/ORIG	1-9	CH. 1	CH. 2
iii/iv	ORIG/ORIG	CH. 2/CH. 2	2-37/2-38	ORIG/ORIG	CH. 2/CH. 2
v/vi	ORIG/ORIG	ORIG/CH. 2	7-63/7-64	CH. 1/ORIG	CH. 1/CH. 2
vii/viii	CH. 1/ORIG	CH. 2/ORIG	7-64A/7-64B		CH. 2/CH. 2
			8-OI/8-OM		CH. 2/CH. 2

2. Destroy superseded pages after the complete book has been checked against the "List of Effective Pages".

3. Make appropriate entry in "Record of Changes Page".

4. Insert this "Instructions" sheet just behind the front cover, and just before CHANGE 1.

NAVSHIPS 91634(A)

INSTRUCTION BOOK

for

RADAR SET AN/SPS-5

RAYTHEON MANUFACTURING COMPANY
WALTHAM, MASSACHUSETTS, U. S. A.

BUREAU OF SHIPS DEPARTMENT OF THE NAVY

Contract: NObsr-52338

Approved by BuShips: 14 August 1952
Change 2: 10 September 1956

LIST OF EFFECTIVE PAGES

Replacement Pages

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	2	3–25 to 3–26	1	7–111 to 7–122	Original
A	2	3–27	Original	7–123	1
B and C	Original	4–0 to 4–4	Original	7–124	1
i	2	5–1 to 5–6	Original	7–127 to 7–132	Original
ii	Original	5–7	1	8–0A to 8–0H	1
iii, iv	2	5–8 to 5–9	Original	8–0I to 8–0M	2
v	Original	6–1 to 6–6	Original	8–1 to 8–49	Original
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1–0 to 1–2	Original	7–3 to 7–18	Original	8–81 to 8–158	Original
1–3	2	7–19	1	8–160 to 8–189	Original
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1–9	2	7–28	1	8–236	Original
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2–10	1	7–43	Original	8–248 to 8–251	Original
2–12	Original	7–45 to 7–51	Original	8–253 to 8–254	Original
2–15 to 2–16	Original	7–53 to 7–60	Original	8–256 to 8–260	Original
2–19 to 2–22	Original	7–62	Original	8–263 to 8–264	Original
2–24 to 2–25	Original	7–63	1	8–266 to 8–275	Original
2–28	Original	7–64	2	8–277 to 8–280	Original
2–31 to 2–33	Original	7–64A, 7–64B	2	8–282 to 8–288	Original
2–35 to 2–36	Original	7–66 to 7–68	Original	8–291 to 8–293	Original
2–37, 2–38	2	7–70 to 7–73	Original	8–296 to 8–300	Original
2–39 to 2–42	Original	7–75 to 7–100	Original	8–302 to 8–303	Original
3–1 to 3–3	Original	7–101	1	8–305 to 8–339	Original
3–4	1	7–102	1	8–341 to 8–347	Original
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Pages Corrected With Pen and Ink

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2–13	1	7–61	1	8–247	1
2–14	1	7–65	1	8–252	1
2–17	1	7–69	1	8–255	1
2–18	1	7–74	1	8–261	1
2–23	1	7–109	1	8–262	1
2–26	1	7–110	1	8–265	1
2–27	1	7–125	1	8–276	1
2–29	1	7–126	1	8–281	1
2–30	1	8–50	1	8–289	1
2–34	1	8–52	1	8–290	1
6–7	1	8–159	1	8–294	1
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GUARANTEE

The equipment, including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f. o. b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten percent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred percent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

TABLE 1-2. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	AN TYPE DESIGNATION	OVER-ALL DIMENSIONS			VOLUME*	WEIGHT*
			HEIGHT	WIDTH	DEPTH		
1	Receiver-Transmitter, Radar Including: Receiver, Radar Transmitter, Radar	RT-202/SPS-5 R-382/SPS-5 T-277/SPS-5	20-7/16	21-3/16	21-3/4	5.48	108
1	Modulator, Radar	MD-133/SPS-5	16-9/16	19-1/4	13	2.37	67
1	Indicator, Azimuth-Range	IP-120/SPS-5	25-1/4	22	25	8.82	234
1	Power Supply	PP-601/SPS-5	28-5/16	22	11-13/16	4.43	160
1	Antenna	AS-511/SPS-5	59-3/4	89	(swing circle)	220.78	166
1	Control, Antenna	C-787/SPS-5	22	18-1/8	13-3/16	3.24	108
1	Couplet, Directional	CU-245/U	4-3/8	3	17-1/2	0.13	3
1	Cavity, Tuned	FR-66/UP	8	8	17	0.63	23
1	Radar Test Set	AN/UPM-79	7¼	9¼	6¾	.25	6
	Field Change 2—AN/SPS-5 c/o Indicator, Standing Wave Ratio	IM-120/UPM-79	7	4½	4	.07	4
	Case, Indicator	CY-1978/UPM-79	7¼	9¼	6¾	.25	2
						246.13	875

*Unless otherwise stated, dimensions are inches, volume cubic feet, weight pounds.

trace and the center of the PPI screen is directly proportional to the distance of the target from the Antenna. The target range is estimated by noting the position of the target trace with reference to fixed range markers superimposed on the radial sweep.

Target ranges up to 40,000 yards are accurately determined by means of a variable range ring. The position of the variable range ring along the sweep trace is adjusted by means of a handcrank until the ring coincides with the signal to be ranged. The range is then read directly from the calibrated dial mechanically coupled to the handcrank.

b. OPERATION OF THE SYNCHRO SYSTEM.

The synchro system of the AN/SPS-5 may be divided into two parts: namely, elevation and azimuth.

The elevation synchro system is comparatively simple, consisting of a synchro generator driven at three speed in the Antenna and a synchro connected to the Bearing Dial in the Indicator. Since the Antenna may be elevated from zero to +65 degrees and the Antenna synchro is driven at three speed, the Antenna elevation of zero to +65 degrees is spread over 195 degrees of the ANTENNA ELEVATION Indicator Dial.

The azimuth synchro system is normally a two-speed system (1 and 36 speed), but will operate from 1-speed or step-by-step OSC information (with proper connections and adjustment of the servo amplifier in the Antenna Control). Relative-bearing information from the Antenna is fed to the bearing conversion assembly in the Antenna Control, where the information is combined with OSC information from the ship's compass to produce true-bearing information. True-bearing information is then transmitted to the Indicator where the deflection coil is servo controlled. If relative-bearing information is desired, the bearing conversion assembly is bypassed and the relative-bearing information from the Antenna is transmitted directly to the Indicator.

i. RANGE OF EQUIPMENT

The range of the equipment depends primarily upon the location, size, and character of the target; the Antenna height; and existing weather conditions. Because of the high-frequency (X_{B-1}) band, considerable reduction of maximum range may experienced during heavy snow or rain storms. The range of the equipment with respect to aircraft depends on the altitude, aspect angle, and on the number of planes.

TABLE 1-3. SHIPPING DATA

SHIPPING BOX NO.	CONTENTS			OVER-ALL DIMENSIONS			VOLUME*	WEIGHT*
	NAME	DESIGNATION	QTY.	HEIGHT	WIDTH	DEPTH		
1	Receiver-Transmitter, Radar	RT-202/SPS-5	1	29	30	32	16.0	250
	Consisting of:							
	Receiver, Radar	R-382/SPS-5	1					
	Transmitter, Radar	T-277/SPS-5	1					
	Terminal Kit (attached)		1					
	Instruction Book	NAVSHIPS 91634 (A)	2					
	Operator's Handbook	NAVSHIPS 91634 (A).2	2					
	Maintenance Handbook	NAVSHIPS 91634 (A).3	2					
	Operating Instruction Plaque		1					
	Lubrication Charts		1 Set					
	Maintenance Drawings		1 Set					
2	Indicator, Azimuth-Range	IP-120/SPS-5	1	27	31	37	18.0	336
	Terminal Kit (attached)		1					
3	Modulator, Radar	MD-133/SPS-5	1	18	25	21	5.5	115
	Terminal Kit (attached)		1					
4	Power Supply	PP-601/SPS-5	1	18	26	35	9.5	230
	Terminal Kit (attached)		1					
5	Antenna (see box 6)	AS-511/SPS-5	1	22	27	37	12.3	200
	Consisting of:							
	Pedestal Assembly		1					
	Terminal Kit (attached)		1					
	Envelope, containing 6 cotter pins		1					
6	Antenna reflector and support	—	1	46	51	95	130.0	361
7	Control, Antenna	C-787/SPS-5	1	18	23	28	6.8	166
	Terminal Kit (attached)		1					
8	Tuned Cavity (Echo Box)	FR-66/UP	1	32	20	28	6.8	76
	Coupler, Directional	CU-245/U	1					
	Field Change 2—AN/SPS-5 c/o Indicator, Standing Wave Ratio	IM-120/UPM-79	1					
	Case, Indicator	CY-1978/UPM-79						
9	Miscellaneous and Interconnecting Material, as follows:			18	21	33	7.5	72
	Viewing Hood (large)**		1					
	Cable, coaxial (pulse cable)	RG-26A/U	75 ft					

*Unless otherwise stated, dimensions are inches, volume cubic feet, weight pounds.
**For use with Azimuth-Range Indicator.

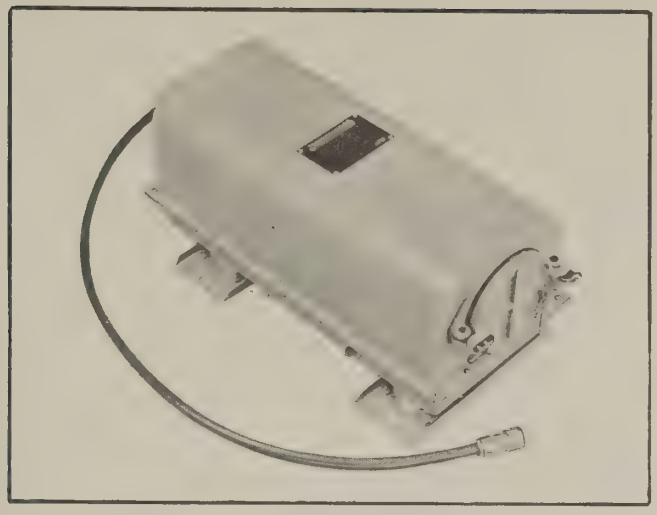


Figure 1–9. Tuned Cavity FR-66/UP

b. TUNED CAVITY FR-66/UP (*See Figure 1-9*)

The Tuned Cavity (echo box) is a resonant cavity whose interior volume is adjustable by means of a piston. The Tuned Cavity constitutes a high-Q tuned circuit whose energy storage properties are used to provide an artificial echo on the screen of the PPI tube for tuning the Receiver in the absence of actual targets. The cavity is mechanically tuned to the magnetron frequency each time that a new magnetron is installed. An electric motor is used to tune the cavity back and forth across the center frequency.

The Tuned Cavity receives its excitation from the Directional Coupler which is permanently installed as a section of the waveguide.

Figure 1–10. Radar Test Set AN/UPM-79 Standing Wave Ratio Indicator IM-120/UPM-79, with Carrying Case CY-1978/UPM-79

i. STANDING WAVE RATIO INDICATOR IM-120/UPM-79 (*See Figure 1-10*)

The Standing Wave Ratio Indicator is designed for temporary insertion into the slotted section of Directional Coupler CU-245/U (*See Figure 1-3*) to provide measurement of the overall standing wave ratio of the waveguide and the Antenna system.

Standing Wave Ratio Indicator IM-120/UPM-79 is contained within a metal carrying case CY-1978/-UPM-79. Located on the inside of the cover is a crystal holder with five spare IN25 crystals.

TABLE 1-4. ELECTRON TUBE COMPLEMENT

	NUMBER OF TUBES OF TYPE INDICATED																														Total No. of Tubes
	OA3/VR75	OD3/VR150	1B50	1B51	1Z2	2D21W	2K26	3B24W	3B29	4J57	4-65A	5C22	5R4GY	5Y3GT	6AG7	6AH6	6AK5W	6AL5W	6AN5	6AN5WA	6AQ5	6AS6	6AS7	6D4	6J6W	6X4	6Y6	10KP7	12AT7	12AU7	807	
Radar Receiver-Transmitter RT-202/SPS-5 Radar Transmitter T-277/SPS-5			1	2	1		1			1																1			1			8
Radar Receiver R-382/SPS-5																	10	5		1				1	4							21
Azimuth Range Indicator IP-120/SPS-5					1	2									4	1		4			4	2				1		1	22	2	3	47
Radar Modulator MD-133/SPS-5								3	1		1	1							1											1		8
Antenna Control C-787/SPS-5																					2								3			5
Power Supply PP-601/SPS-5	1	2											5	1			4						4			2	5					24
Total Number of Each Type	1	2	1	2	2	2	1	3	1	1	1	1	5	1	4	1	14	9	1	1	6	2	4	1	4	4	5	1	26	3	3	113

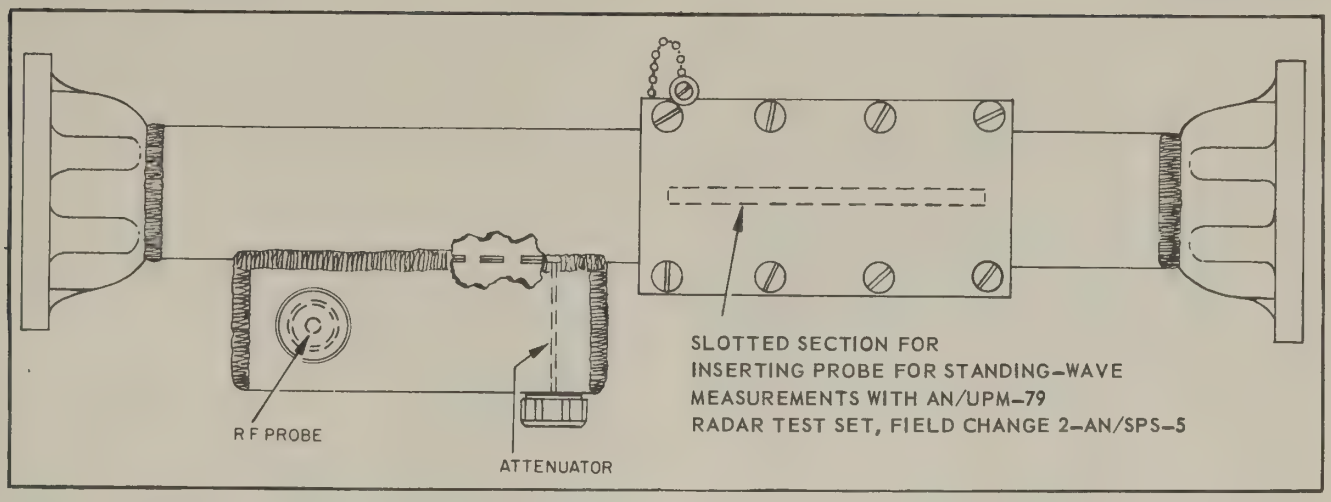


Figure 2–25. Directional Coupler CU-245/U: Simplified Diagram

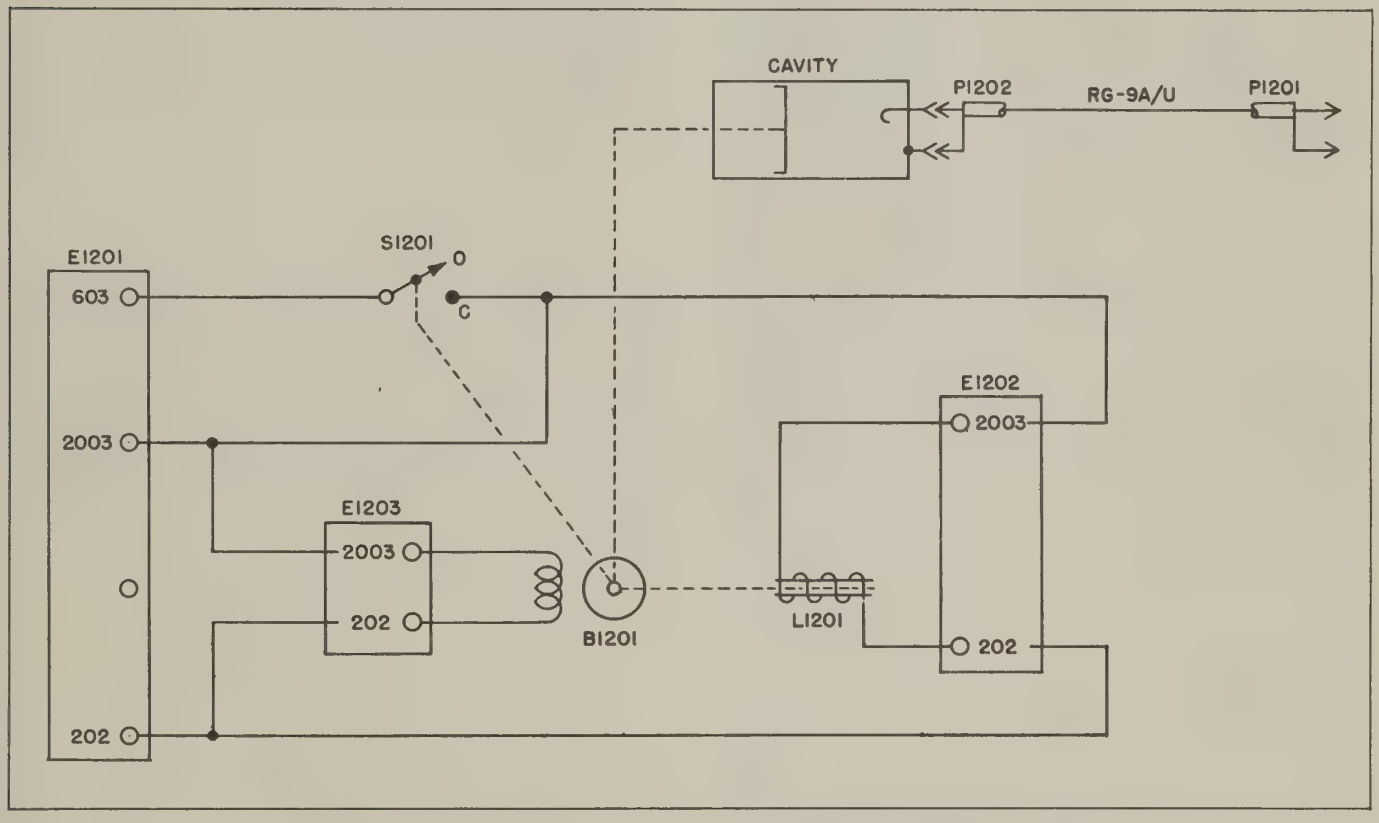


Figure 2–26. Tuned Cavity FR-66/UP: Schematic Diagram

Elevation of the Antenna reflector from 0 to +65 degrees is provided. A DC drive motor and gear train provide power for elevation of the Antenna.

b. RF SYSTEM.

The RF portion of the Antenna comprises a waveguide, two waveguide rotary joints (one for rotation and one for elevation), a pyramidal horn, and a parabolic reflector.

Microwave energy is transmitted to the waveguide pyramidal horn, which radiates energy to the slatted parabolic reflector. The rectangular section of the pyramidal horn confines the vertical radiation pattern of the horn to prevent overshooting of the reflector. The reflector and pyramidal horn are so constructed and are so located that the Antenna beam pattern is of approximately cosecant-squared configuration. The beam in the vertical plane (0 degree in the horizontal plane) covers from —7.5 to +7.5 degrees and from +7.5 to +22 degrees. The beam in the horizontal plane (0 degree in the vertical plane) is 1.5 degrees wide at the half-power points. The field patterns

showing radiation in the vertical and horizontal planes are shown in figures 2-27 and 2-28.

12. SYNCHRO SYSTEM (*See Figure 2-29*)

The synchro system of the AN/SPS-5 may be divided into two parts: the elevation and the azimuth synchro systems.

The *elevation synchro system* is comparatively simple, consisting of an 18TR6 synchro in the Antenna and an 18TR6 synchro in the Indicator. Since the Antenna may be elevated from 0 to +65 degrees and the Antenna synchro is driven at three speed, the Antenna elevation of 0 to +65 degrees is spread over the 195 degrees on the ANTENNA ELEVATION Indicator Dial. This is for convenience in reading the ANTENNA ELEVATION Indicator Dial.

The *azimuth synchro system* is both a 1- and 36-speed system to obtain good bearing accuracy. Relative bearing 1- and 36-speed synchro information is generated in the Antenna by two 31TX6 synchros, B602 and B603, respectively. This relative bearing 1- and 36-speed information is transmitted to two 31TDX6 synchros, B504 and B505, respectively, in the bearing conversion assembly in the Antenna Control. The rotors of these two 31TDX6 synchros are driven through a mechanical differential by two-phase motor B501. The 1- and 36-speed information (OSC) supplied by the ship's gyro compass is fed to two 18CT6 synchros, B502 and B503, respectively (in the bearing conversion assembly), which are also driven by the mechanical differential. Error voltage from B502 and B503 is fed to the bearing conversion servo amplifier in the Antenna Control, which controls B501 (mechanical differential drive motor). B504 and B505 now feed true-bearing information to 1- and 36-speed 1HCT synchros in the Indicator. The two 1HCT synchros in the Indicator are mechanically connected to the PPI deflection coil. Error voltage from the 1HCT synchros in the Indicator is fed to a bearing servo amplifier (in the Indicator), which controls the two-phase drive motor for the deflection coil. The system may be used to indicate relative bearing by switching the information from the Antenna synchro directly to the Indicator synchros by means of a relay, instead of mixing the Antenna synchro information with the OSC information in the bearing conversion assembly in the Antenna Control.

The equipment is designed to accept 1- and 36-speed synchro data, 1-speed synchro data, or step-by-step data. The normal and most accurate data are from 1- and 36-speed OSC information. For this condition, OSC data are supplied to B502 and B503. In the event that only 1-speed synchro data are available, the OSC data are supplied to B502 only and the gain of the servo amplifier is increased by adjusting R515. In the event that step-by-step data are available, the OSC data are supplied to step motor B507, which is coupled to B508 (an 18TR6 synchro, driven at 1-speed by the step motor). The output of B508 is 1-speed synchro data.

13. RADAR TEST SET AN/UPM-79 (*See Figures 2-25 and 2-26A*)

This indicator provides a means of measuring the standing wave ratio in the waveguide and relative RF power output. The standing wave ratio is measured by removing the cover from the waveguide slot, inserting the three probes and the two alignment pins located at the rear of the indicator, into the slot. The probes feed a crystal detector (1N25) and the rectified output operates a meter which indicates the standing wave ratio.

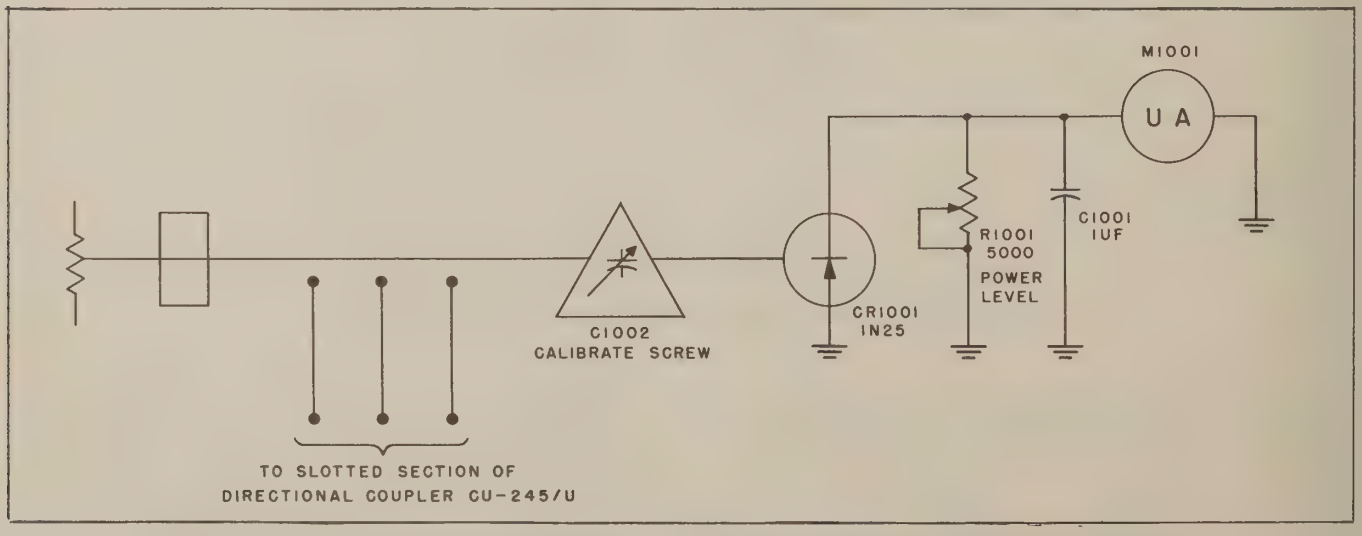


Figure 2–26A. Standing Wave Ratio Indicator AN/UPM-79: Schematic Diagram

(2) TUNED CAVITY TUNING
(*See Figure 7-65*).

(*a*) Start the radar set in the usual way (Antenna not rotating; range selector switch in 4-mile position).

(*b*) Throw ECHO BOX Switch S711 on the Indicator to the ON position.

(*c*) Using sound-powered phones for communication — one set at the Indicator and the other set at the Tuned Cavity — turn the Tuned Cavity Tuning Control until a flashing line appears on the PPI screen on the Indicator.

(*d*) Start the Antenna rotating in the usual way.

(*e*) Carefully adjust the Tuned Cavity Tuning Control until several elliptically shaped lobes are evenly spaced on the PPI screen.

(*f*) The Tuned Cavity is now tuned correctly for the magnetron installed and the cover plate may now be replaced on the front of the unit. Make sure that the two wing nuts are tight to prevent any moisture from getting inside the case.

(3) USE OF TUNED CAVITY FR-66/UP (Echo Box).

(*a*) GENERAL.

The calibrated Tuned Cavity FR-66/UP (echo box) serves as a valuable test unit for several purposes. Its ringing time, as seen on the PPI screen of the Azimuth-Range Indicator, provides an excellent daily check of system performance. The echo box is also useful as an RF test instrument to tune the radar and to isolate trouble. Trouble-shooting information is given in paragraph 5.*g*.(1) above.

The various uses of the Tuned Cavity are as follows:

Checking Over-all Performance (paragraph (*b*) below)
Checking Magnetron Output and Spectrum (paragraph (*c*) below)
Checking Magnetron Frequency When Pulling is Suspected (paragraph (*d*) below)
Checking AFC Locking-In (paragraph (*e*) below)

(*b*) CHECKING OVER-ALL PERFORMANCE.

To check the over-all performance, throw ECHO BOX Switch S711 on the Azimuth-Range Indicator to the ON position. If the equipment is operating correctly, a solid flashing line extending from the center of the PPI screen out to about 3700 yards will appear.

Since the Tuned Cavity is connected to the Directional Coupler in the waveguide run, any faults in the waveguide run beyond the Directional Coupler or in the Antenna will not show up in tests of the Tuned Cavity. However, the standing-wave ratio — paragraph 5.*f*.(2) — may serve to indicate faults in the waveguide run or in the Antenna.

Because a loss in system performance affects the maximum range on small targets (such as a cruiser), the Tuned Cavity provides a much more reliable indication of system performance than can be obtained by the use of targets. Also, it is not affected by weather conditions as are targets. The temperature correction of ringing time is small, although the ringing time may be several hundred yards greater at very low temperatures. However, the effect of humidity is larger, which may cause the ringing time to drop appreciably on very humid days.

(*c*) CHECKING MAGNETRON OUTPUT AND SPECTRUM.

To check the magnetron output, tune the Tuned Cavity for a maximum indication on the PPI screen of the Azimuth-Range Indicator. The observed reading is a relative measure of the magnetron output. However, the readings do give an accurate comparison of the outputs from several different magnetrons if they are checked at about the same time.

To check the magnetron spectrum, tune the Tuned Cavity through its entire tuning range. As the Tuning Control (on the Tuned Cavity) is rotated in one direction there will normally be at least one minor peak, a major peak, and another minor peak on the other side of the center frequency. These secondary peaks should always be less than one-fourth the amplitude of the major peak and located symmetrically about the center frequency. If several major peaks of approximately the same amplitude are observed, the magnetron is probably defective and should be replaced, after first checking to make sure that the standing-wave ratio at the slotted section in the Directional Coupler is not excessive.

The spectrum can be plotted by recording the ringing time indicated on the PPI screen. A magnetron with a poor spectrum may operate satisfactorily on manual tuning, but give erratic results on AFC tuning.

(*d*) CHECKING MAGNETRON FREQUENCY FOR PULLING.

The Tuned Cavity provides a convenient check for magnetron pulling (variations in output frequency caused by a faulty rotary joint or the presence of very close reflecting objects near the Antenna). This pulling can be a serious difficulty as it may vary the magnetron frequency so rapidly that the AFC circuit cannot maintain the local oscillator in tune, thereby causing poor signals.

To check the magnetron frequency for pulling, proceed as follows:

1. Measure the ringing time on the PPI screen of the Azimuth-Range Indicator, with the Antenna rotating and Echo Box Switch on Indicator off.

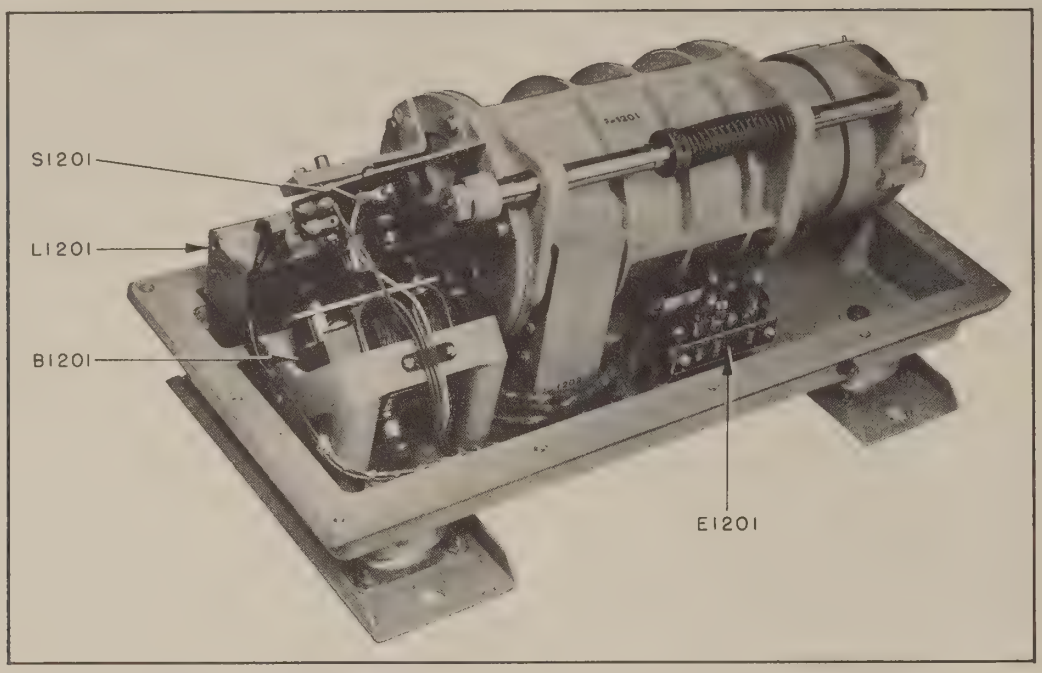


Figure 7–66. Tuned Cavity FR-66/UP: Component Locations

Note

Variations in ringing time at various bearings indicate pulling of the magnetron, which may be caused by a faulty rotary joint or by reflecting surfaces (such as the mast) in the path of the Antenna beam.

2. If variations in ringing time are noted as the Antenna rotates, stop the Antenna on a bearing where the ringing time is reduced and return the Tuned Cavity for a maximum indication on the PPI screen.

3. Rotate the Antenna once more, and using AFC tuning, check the ringing time. If the AFC circuit is following properly, the ringing time should not vary with rotation of the Antenna. The ringing time may have decreased slightly at those bearing where it was originally good, but this is not significant. If the AFC circuit does not follow, the pulling may be excessive or the AFC circuit may be at fault.

(*e*) CHECKING AFC LOCKING-IN.

To determine whether the AFC circuit is locked in at the proper frequency, stop the Antenna and tune the Tuned Cavity for a maximum indication on the PPI screen of the Azimuth-Range Indicator. With the AFC *on,* measure the ringing time. Then, with the AFC *off,* adjust the TUNE Control on the Indicator for a maximum ringing time. The two ringing times should be identical.

If the ringing time on AFC is even slightly less than on manual tuning, the AFC circuit is probably not centered on the signal IF channel frequency. This misalignment can be caused by incorrect tuning of the local oscillator, the AFC IF stage, or the AFC discriminator stage. However, a bad magnetron spectrum can also cause improper AFC operation and the magnetron should be checked before attempting to align the AFC circuit in the Radar Receiver.

b. RADAR TEST SET AN/UPM-79.

(1) INITIAL CALIBRATION (*Refer to Figure 7-66A*)

Before using the indicator make the following initial calibration adjustments:

(*a*) Loosen the eight captive bolts that secure the protective cover plate to the slotted section of Directional Coupler CU-245/U, and remove cover plate.

(*b*) Energize Equipment.

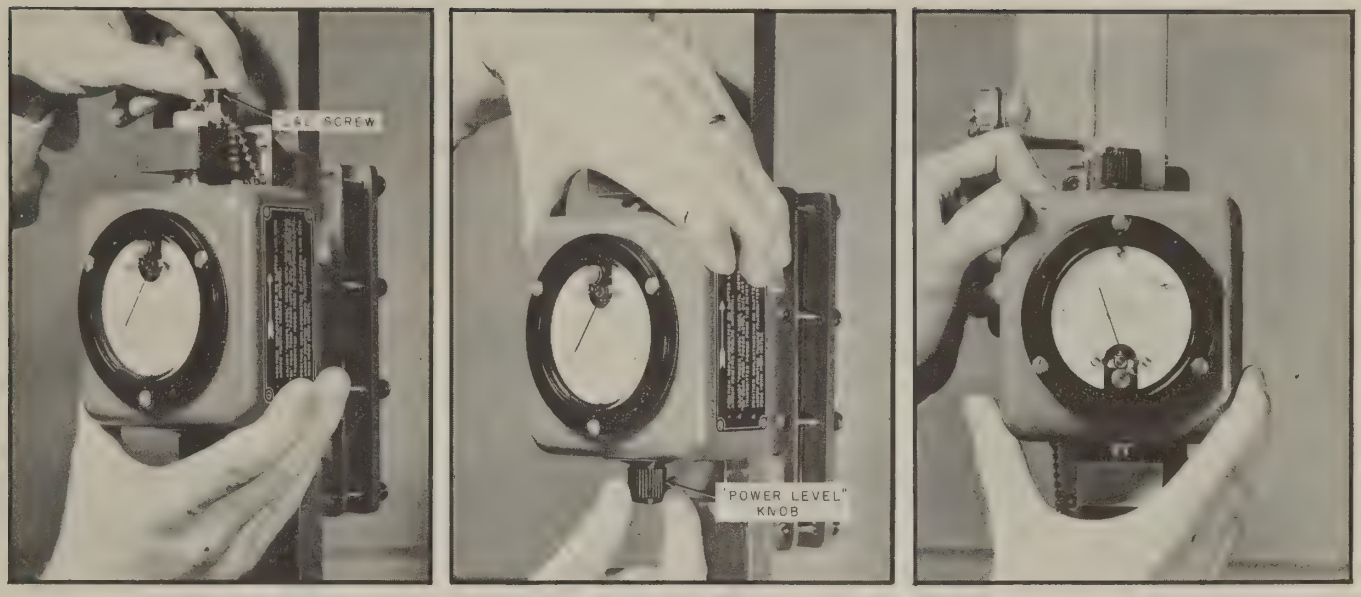
(*c*) Set "Power Level" knob to zero unless some other reference level is indicated. (See para. *i.*).

(*d*) Position VSWR INDICATOR AN/-UPM-79 on slotted line with arrow pointing toward antenna.

(*e*) Loosen locknut slightly, and adjust "CAL" screw until meter reads ∞. Tighten locknut.

Note

Always repeat initial calibration procedure after changing crystals. The equipment calibrated, proceed to measure the standing-wave ratio using the following operating instructions.



Adjustment of "CAL" Screw | Adjustment of "Power Level" Knob | Reading Standing Wave Ratio

Figure 7–66A. VSWR Indicator in Position on Slotted Line

(2) OPERATION

(*a*) (*Refer to Figure 7-66A*) Position VSWR INDICATOR on slotted line with arrow pointing toward antenna.

(*b*) Adjust "Power Level" knob until meter reads infinity. Read from "Power Level" dial any change in transmitted power from the reference level.

(*c*) (*Refer to Figure 7-66A*) Position VSWR on slotted line with arrow pointing toward transmitter. Read voltage standing wave ratio from meter.

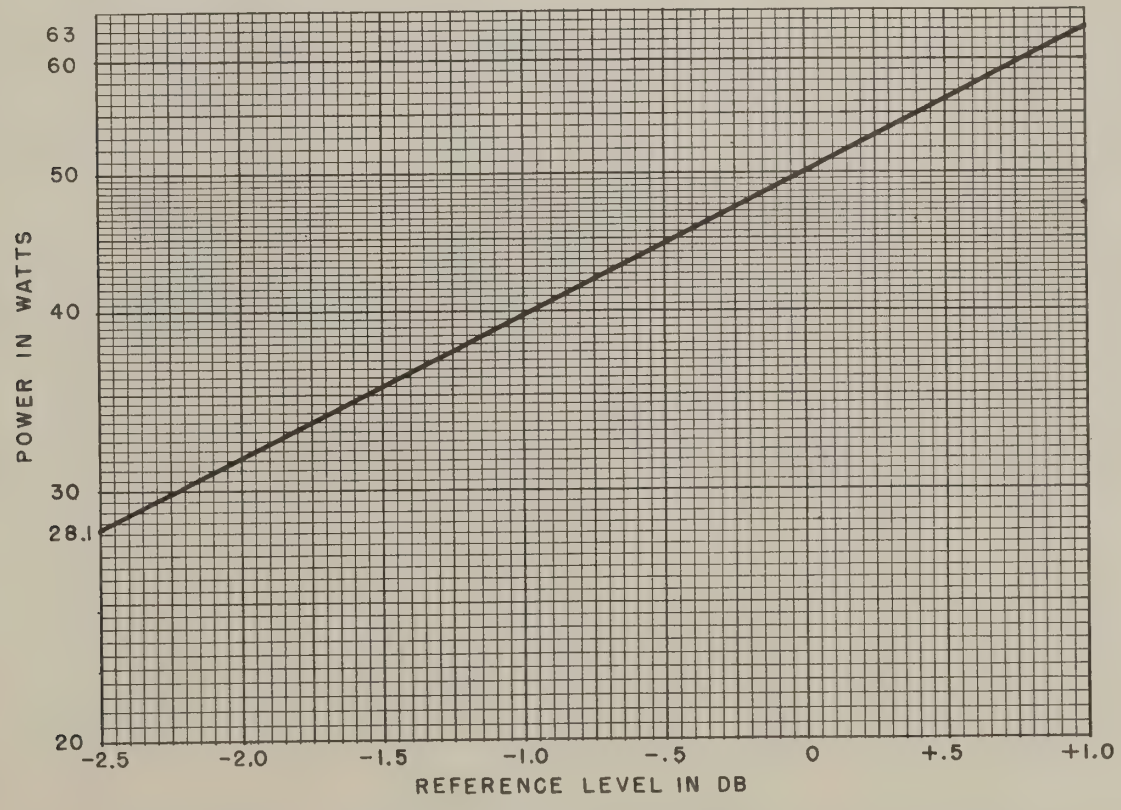


Figure 7–66B. Conversion Graph for use with Radar Test Set AN–UPM-79

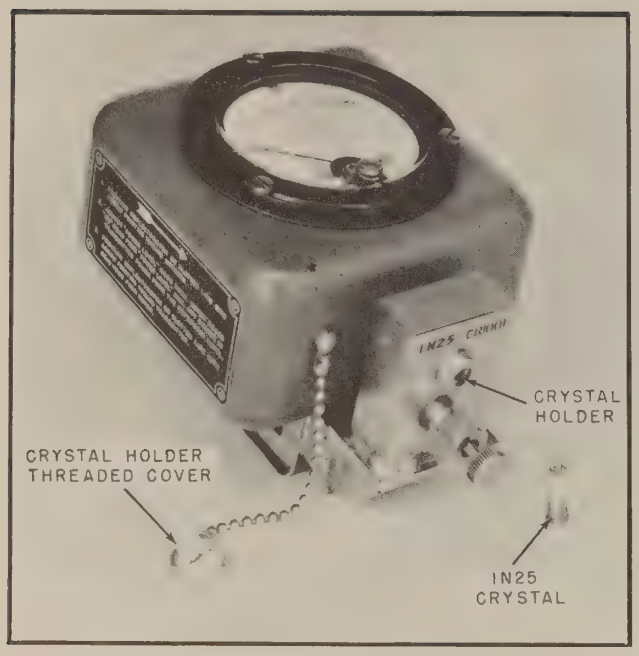


Figure 7–66C. Standing Wave Ratio Indicator IM-120/UPM-79: Replacement of 1N25 Crystal

Note

When reading the voltage standing wave ratio, carefully slide the VSWR INDICATOR up and down on the slotted line. Record the average reading.

(3) ALIGNMENT PROCEDURE (*Refer to Figure 7-66B*)

If a water load or other such equipment capable of measuring the transmitter average power level is available, the reference level used at the time of initial calibration may be determined from the conversion graph (*Figure 7-66B*). Measurements of power level made with the VSWR INDICATOR (OPERATION, Step (*b*)), will then show the comparison between the transmitter power level and the normal power level of 50 watts.

If power measuring equipment is not available when the initial calibration is made, use zero as the reference level. Measurements of power level made with the VSWR INDICATOR (OPERATION, Step (*b*)), will show the comparison between the transmitter power level and the power level which existed at the time of the latest initial calibration.

(4) Replacement of 1N25 Crystal (*See Figure 7-66C*)

(a) Unscrew the threaded cap from the crystal holder.

(*b*) Carefully tilt the indicator until the defective crystal slides out.

Note

Extreme care must be used to prevent damage when replacing crystals.

(*c*) Insert crystal slowly, perpendicular to waveguide.

(*d*) Gently feel for proper seating before applying light pressure.

(*e*) Replace the threaded cap removed in step (*a*), above.

i. ANTENNA AS-511/SPS-5.

(1) GENERAL (*See Figure 7-67*).

After this unit has been installed and the ship's heading microswitches have been adjusted (as outlined in paragraph 5.*h.*(5), below) and the synchro system has been aligned, it will only be necessary to check the oil in the base of the Antenna periodically. No extensive servicing should be attempted with the Antenna mounted on the mast.

The following illustrations will aid the technician in trouble shooting in this unit:

Figure 7-97. Antenna AS-511/SPS-5: Schematic Diagram

Figure 7-83. Antenna AS-511/SPS-5: Practical Wiring Diagram

Figures 7-68 through 7-71 show component locations.

WARNING

Make sure that the equipment is turned off, that the Antenna Safety Switch is in the OFF position, and that the Main Line Switch is pulled.

(2) ANTENNA DISASSEMBLY.

For Antenna overhaul or major replacement, the unit must be removed from the mast and dis-

TABLE 8-4 TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION
		TEST SET, RADAR: c/o Indicator, Standing Wave Ratio and carrying case, AN/UPM-79; Raytheon Unit #2561-5004G1.	
		INDICATOR; STANDING WAVE RATIO: IM-120/UPM-79; Raytheon Unit #2561-5001G1.	P/o Radar Test Set AN/UPM-79
		CASE, INDICATOR: CY-1978/UPM-79. Raytheon Unit #2561-5002G1.	Carrying Case
A1001	Shop Manufacture	PLATE, END: 1/2 hard yellow brass per MIL-B-895; bright silver plated over-all dim. 1-1/2 in. lg, 47/64 in. wide, 1/4 in. deep; bevelled to 1.367 in. max lg, 0.617 in. max wide, 3/16 in. high w/a No. 2-56 NC-2 by 3/16 in. full threaded hole in ea end of bevelled sections; incl 4 equally spaced slots 0.040 in. max wide; Raytheon Part #2561-1012P1.	Holding plate for E1003, E1004
C1001	N16-C048808-9019	CAPACITOR, FIXED, PAPER DIELECTRIC: JAN Type #CP08A1KB105K; working voltage 100 V DC, 1.0 mf, ±10%; uninsulated hermetically sealed tubular metal case, 1-5/8 in. lg by 0.670 in. dia; Spec MIL-C-25A; Raytheon Part #235-1257P263.	Protective by-pass for M1001
CR1001	N17-T-51725	CRYSTAL UNIT, RECTIFYING: JAN Type 1N25; silicone diode; ceramic body, brass base and tip; brass gold plated; over-all dim. 0.820 in. lg, 0.294 in. OD; Spec JAN-1A; Raytheon Part #322-1025P1.	VSWR line rectifier

TABLE 8-4A TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION
E1001	N17-C-081969-6019	CONDUCTOR, INNER: hard temper beryllium copper per MIL-C-947, condition H; silver rhodium plate heat treat to Rockwell C38 min; over-all dim. 1 in. lg by 0.375 in. max dia, 0.134 in. max dia over body; 4 slots equally spaced one end 3/8 in. deep, other end has 0.060 in. wide by 1/16 in. dia groove 0.030 in. from end; Raytheon Part #2027-1029P2.	P/o waveguide ass'y.
E1002	Shop Manufacture	INSULATOR: Rexolite #1422 material used; over-all dim. 0.436 in. max dia by 0.132 in. max thick; 0.126 in. max dia center hole; Raytheon Part #2027-1009P1.	Insulating washer for indicator
E1003	N16-R040699-1027	RESISTOR, CARD: made from 0.027 in. thick material, 200 ohms, ±10% per square as purchased form International Resistance Co., Phila. Pa.; over-all dim. 2.750 in. lg. 0.617 in. max wide, angular cut from 0.400 in. at one end to 0.032 in. other end; cemented to end plate, A1001; Raytheon Part #2561-1013P1.	P/o end plate ass'y. A1001
E1004	N16-R040699-1117	RESISTOR, CARD: made from 0.027 in. thick material, 400 ohms, ±10% square as purchased from International Resistance Co., Phila, Pa.; over-all dim. 2.750 in. lg, 0.617 in. max wide, angular cut from 0.400 in. at one end to 0.032 in. other end; cemented to end plate, A1001; Raytheon Part #2561-1013P2.	P/o end plate ass'y. A1001
E1005	For Replacement Use SNSN N17-T059591-6929	TERMINAL: hermetically sealed; Kovar metal body, hard glass insulation; fused electro-tinned plated; 3 amp current capacity, rms test voltage 1000 at 90 per cent humidity at sea level; over-all dim. 0.339 in. max lg by 0.125 in. body dia; 0.175 in. dia mounting flange; Electrical Industries, Inc., Type AAA-30W-SS Modified; Raytheon Part #227-1227P1.	

TABLE 8-4 TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION
E1006	N17-T059591-6929	TERMINAL: hermetically sealed; Kovar metal body, hard glass insulation; fused electro-tinned plated; 3 amp current capacity, rms test voltage 1000 at 90 per cent humidity at sea level; over-all dim. 0.400 in. max lg by 0.125 in. body dia. 0.175 in. dia mounting flange; Electrical Industries, Inc., Type AAA-30W-SS Modified; Raytheon Part #227-1227P2.	
E1007	N16-W021998-1127	WAVEGUIDE ASSEMBLY: c/o two sections of waveguide w/joining elbow 2 brackets, housing and crystal seat, tuning seat and choke insert; assembly silver brazed and bright silver plated; approx over-all dim. 7-3/32 in. lg, 2-1/2 in. wide, 3-5/16 in. high; bracket mounted; marked "1N25" and "CR1001" in 1/8 in. high characters; Raytheon Part #141-6819G1.	P/o indicator ass'y.
H1001	Shop Manufacture	NUT, SELF-LOCKING, HEXAGON: 1/2 hard free cutting yellow brass per MIL-B-895; bright silver plate; 3/8 in. high by 9/16 in. across hex flats; 3/8 in. -32 NEF-2 thread, 1/4 in. dia hole at top; Raytheon Part #2561-1014P1.	Cal. adj. tightening nut
H1002	Shop Manufacture	SCREW, MACHINE: SS passivated; 1/2 in. dia knurled head 3/16 in. high; over-all lgth 1-3/8 in.; No. 6-32 NC-2 thread over 1-1/8 in. lgth; marked "CAL" on head in 1/8 in. high characters; Raytheon Part #2561-1020P1.	Calibration adjusting screw
H1003	Low Failure item - if required, requisition from ESO referencing NavShips 900, 180A	CATCH, SPRING LOADED: c/o SS strike and catch, both painted gray; catch has compression of 60 lb load at 1/8 in. max deflection; over-all dim. 2-47/64 in. lg, 1-5/64 in. wide, 2 holes ea in catch and strike for No. 6-32 NC-2 screws, 9/16 in. C to C on catch, 5/16 in. C to C on strike; Corbin Cabinet Lock Division, #15834-SS painted; Raytheon Part #373-1049G4.	Case cover catch
H1004	Shop manufacture	HANDLE: annealed SS, sandblast then black passivate; over-all dim. 3/8 in. dia rod, 4-3/8 in. lg, 1-9/32 in. high; mounts by 2 No. 10-24 NC-2 threaded holes 3/8 in. deep, one each end; Raytheon Part #231-1045P4.	Case carrying handle

TABLE 8-4A TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION
H1005	For Replacement Use Fed. Stk. #G5340-223-4176	HINGE: leaf aluminum 5052-H34, anodized per AN257-P4-7200, pin non-magnetic, SS passivated; over-all dim. 7-1/2 in. lg, 1-1/2 in. wide, 0.170 in. high; 5 mounting holes, Q.201 in. max dia, in ea leaf 1-5/8 in. between ctrs in ea row 7/8 in. apart; hinge pin 1/4 in. shorter than hinge, loops one-half closed; non binding; Raytheon Part #2561-1009P1.	Case lid hinge
H1006	For Replacement Use Fed. Stk. #G5310-265-7968	NUT, WING: forged steel, No. 8-32 NC-2 thd size dim. 13/16 in. wing spread, 7/16 in. wing height, 0.168 in. body height, 0.415 in. body dia, 0.238 in. between wings; Sharon Bolt and Screw, No Number; Raytheon Part #203-1051P3.	Holding nuts for ind. in case
M1001	N17-M032374-6249	METER, MICROAMMETER: 0 to 50 ma DC, shaded pole movement; sealed ruggedized, coil resistance 1175 ohms, ±20% special scale calibrated from 1.0 to infinity, with markings of 1.5, 2, 3, 5 and 10 between; over-all dim. 2.630 in. max high by 3.51 in. max dia; flush mounting w/three 0.150 in. dia holes equally spaced on 1.58 in. radius; hardware incl; two term.; scale marked "Voltage Standing Wave Ratio"; Western Electrical Instrument Corp.; "Special"; Raytheon Part #45-5106P1.	Standing wave ratio indicator
O1001	For Replacement Use SNSN N17-C200867-0876	CAP ASSEMBLY: c/o cap, 4-1/2 in. bead chain and bead couplings; knurled brass cap, silver rhodium plated, 5/8 in. dia by 9/32 in. high w/1/2-18NEF-2 thread, 0.149 in. hole top coupling; Raytheon Part #1756-5007G2.	Cap. to retain CR1001
O1002	For Replacement Use SNSN N16-K702781-0173	KNOB, ROUND: fastens w/two set screws 90 deg apart; knurled; black Tenite, matte finish; max over-all dim. 0.803 in. lg by 1.135 in. dia; dial skirt w/white arrow; accom 1/8 in. shaft vaporetched; Raytheon No. 70-3-1G; Raytheon Part #231-1055G9.	Control knob for R1001

TABLE 8-4A TABLE OF REPLACEABLE PARTS

REFERENCE DESIGNATION	STOCK NUMBER	NAME AND DESCRIPTION	LOCATING FUNCTION
O1003	For Replacement Use Fed. Stk. #G5340-355-4864	BUMPER, RUBBER: Buna "S" synthetic rubber, black w/no. 8-32 NC-2 threaded stud 7/32 in. lg; over-all dim. 3/4 in. dia by 9/16 in. high; Atlantic India Rubber Works, Inc., Part No. 255; Raytheon Part #359-1049P1.	Case protective bumpers
O1004	Shop Manufacture	GASKET: material black Buna "S" 40-50 durometer; over-all dim. 29-3/16 in. lg, 19/32 in. high, 5/16 in. deep; lgth cutout as follows; one end 3-1/2 in. lg by 11/32 in. deep, other end 3-13/16 in. lg by 11/32 in. deep and two 5/8 in. lg by 1/8 in. deep cutouts, one 10-7/8 in. from end, the other 17-3/8 in. from same end; Raytheon Part #2561-1008P1.	Cover gasket
O1005	Shop Manufacture	GASKET: material black Buna "S" 40-59 durometer; over-all dim. 29-3/16 in. lg, 19/32 in. high, 5/16 in. deep; cut one end over 3-1/2 in. lgth by 11/32 in. deep, other end over 3-13/16 in. lgth by 11/32 in. deep; Raytheon Part #2561-1008P2.	Cover gasket
O1006	Fabricate locally from bulk material under Fed. Stk. #G5330-244-0193	GASKET: black rubber, Type RS409 per MIL-R-3065; over-all dim. 3-1/2 in. lg, 3/8 in. wide, 1/4 in. thick; Raytheon Part #2561-1004P1.	Indicator hold-down gaskets
O1007	Fabricate locally from bulk material under Fed. Stk. #G5330-244-0191	GASKET: black rubber, type RS409 per MIL-R-3065; over-all dim. 1-1/2 in. dia, 1 in. wide, 1/16 in. thick; 3/16 in. dia axial hole; semi-circular shape, 1/4 in. greater than half circle; Raytheon Part #2561-1003P1.	Crystal holder gasket
O1008	Fabricate locally from bulk material under Fed. Stk. #G5330-244-0197	GASKET: black rubber, type RS409 per MIL-R-3065; over-all dim. 4 in. sq. by 1/2 in. thick; incl 3-9/16 in. dia axial hole; Raytheon Part #2561-1005P1.	Meter protective case gasket
R1001	For Replacement Use SNSN N16-R087517-2429	RESISTOR, VARIABLE: composition 5000 ohms, ±10%; 1/2 W; linear taper; clock wise rotation; 5/8 in. lg flatted shaft; 3 solder lug terminals; over-all dim. less terminals 1 in. lg by 3/4 in. dia; non-turn device located on 3/8 in. radius at 9 o'clock; Spec MIL-R-94A; Chicago Telephone Supply Corp., Series 65; Raytheon Part #240-1204P5.	Sensitivity adj. for M1001